

Earth System Research Laboratory Chemical Sciences Division

Understanding the chemistry of the atmosphere



Top. Scientists prepare a CSD instrument for deployment in China, to study the effects of soot on regional air quality and climate. Photo courtesy of Ru-Shan Gao, NOAA.

Middle. CSD scientists, using instruments on board the NOAA research vessel *Ronald H. Brown*, determined that cargo ships and other oceangoing vessels emit far more particulate matter pollution than previously estimated. NOAA photo.

Bottom. A NASA aircraft over Alaska, captured from NOAA's P-3 airplane, flying nearby, during a 2008 mission to study Arctic spring-time haze. Photo courtesy of Julie Cozic, NOAA/CIRES.

What Does The Chemical Sciences Division Do For The Nation?

The Chemical Sciences Division (CSD) of the Earth System Research Laboratory (ESRL) conducts research that provides a sound scientific basis for decisions made by industry, government, and the public relating to climate change, air quality improvement, and ozone layer protection.

CSD Scientific Goals

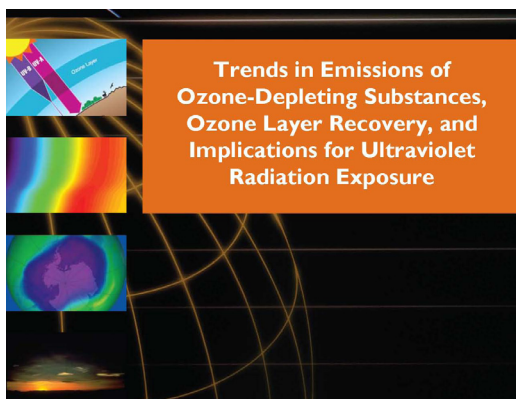
- understanding and quantifying the processes that govern the chemical reactions of Earth's atmosphere.
- conducting laboratory studies, theoretical analyses, and field research to improve computer modeling of regional and global phenomena, from air quality to climate (the heart of NOAA's mission).
- effectively communicating scientific information to NOAA's customers in government, industry, and the public.

Chemical reactions and radiative processes (e.g., heating and cooling) drive atmospheric change. To build better models of the atmosphere, scientists must identify and characterize these processes. CSD scientists focus on understanding the chemical reactions and radiative processes that are important in model predictions of climate, regional air quality, and the stratospheric ozone layer.

In the context of improving predictions, CSD researchers study atmospheric chemistry under controlled laboratory conditions and in diverse field environments, and they carry out theoretical analyses to synthesize the information. They provide scientific information and leadership in efforts to assess the current state of scientific understanding, and they interact with those who use this information. For example, CSD staff served as co-chair of the climate science working group of the United Nations' Intergovernmental Panel on Climate Change (IPCC), which shared the 2007 Nobel Peace Prize, and as co-chair of the international ozone-layer scientific assessment for the United Nations Montreal Protocol.

Recent Accomplishments

- Quantified pollutant emissions from ships, using a new instrument developed at CSD. CSD scientists and colleagues determined that ships (tugboats, tankers, cargo, ferries, and large fishing boats) emit far more particulate pollutants than previously estimated. Soot is a health hazard and can affect climate, and global shipping is expected to increase, including in climate-sensitive areas.
- Conducted a study showing that climate change is largely irreversible, primarily because of the dynamics of Earth's oceans. This century's increase in the greenhouse gas carbon dioxide will "lock in" sea level rise and temperature and precipitation changes for more than 1,000 years.
- Discovered new factors causing Houston's poor air quality, enabling



Top. A NOAA's instrument-laden research aircraft takes off over Denver, Colo., during a 2008 study of the region's air quality. Photo courtesy of Julie Cozic, NOAA/CIRES.
Below. CSD is involved in international efforts to understand the Earth's ozone layer, which protects the planet's surface from damaging radiation. CCSP image.

Texas to adopt more effective air quality improvement strategies that will save 64,000 jobs and \$10 billion for the state by 2010.

- Discovered that wildfires and biomass burning activities in faraway Asia contributed to the 2008 springtime haze over northern Alaska and other Arctic regions.
- Quantified how the Montreal Protocol to protect the Earth's ozone layer has also benefitted climate.
- Led, authored, reviewed, edited, and published international and national scientific state-of-understanding assessments on the climate system, atmospheric particles, and the stratospheric ozone layer. These information products provide key scientific input to pending national and international decisions.

What's Next For CSD?

CSD scientists provide leadership within NOAA's Climate Research and Modeling program and for its Air Quality program, and lead assessment efforts that give decision makers user-friendly information about climate and air quality. During the next five to ten years, CSD scientists will focus on:

- Understanding climate change, especially the radiative effects of fine particles in the atmosphere (aerosols), as well as the roles of water vapor and trace gases, changing chemical composition, and cloud formation and composition. This includes studies on the effect of regional emissions on climate and air quality, and the interaction of climate and air quality.
- Assessing ozone layer recovery, including research into the effect of climate change on the recovery of the stratospheric ozone layer, and understanding how ozone layer changes affect climate. CSD will also continue to evaluate the ozone and climate "friendliness" of proposed chemical substitutes for now-banned ozone-depleting compounds.
- Studying air quality, by identifying factors that contribute to surface ozone pollution in regions of the United States, and determining chemical measurements and analyses needed to support air quality forecasting. This also includes identifying regional factors that affect the formation and chemical composition of atmospheric particles.

Research Partnerships

Most CSD scientists are affiliated with the Cooperative Institute for Research in Environmental Sciences (University of Colorado) or the Cooperative Institute for Research in the Atmosphere (Colorado State University). CSD also has vital research and scientific partnerships with colleagues from other ESRL divisions, other NOAA/OAR laboratories, other departments of the federal government, private industry, and numerous universities and organizations worldwide.

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